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“A Little Science on the Moon”

On Earth it was August 2, 1971. On the Moon it was yet another sunny day with, as usual, no weather at all. (You can't have weather without water or an atmosphere.) Dave Scott and Jim Irwin, the commander and lunar module pilot, respectively, for the *Apollo 15* mission, were winding up the fourth visit by humans to the lunar surface, and they had saved a special event for last.

Standing in front of the garish orange lunar module, Scott held up two objects. “In my left hand I have a feather, in my right a hammer,” he said. “And I guess one of the reasons we got here today was because of a gentleman named Galileo a long time ago, who made a rather significant discovery about falling objects in gravity fields. And we thought that where would be a better place to confirm his findings than on the Moon?”

The camera, controlled remotely from 238,000 miles away in Houston, zoomed in on the hammer and feather, and then zoomed out again just in time for the next act.

“I'll drop the two of them here and hopefully, they'll hit the ground at the same time.” Scott later said that he was worried that the falcon feather might cling to his glove because of static electricity. Fortunately, it didn't. Though the hammer was about fifty times heavier than the feather, they dropped at an identical rate, the hammer sticking upright in the lunar soil for a moment before tipping awkwardly over.

“How about that!” Scott said, speaking over applause from Houston. “Mr. Galileo was correct.” A few seconds later, he added, “Nothing like a little science on the Moon, I always say.”

"Been saying it for years," radioed back Joe Allen, the physicist/astronomer who was serving as capcom (capsule communicator) in Houston. Indeed, many scientists *had* been saying it for years, starting with Harold Urey and Gene Shoemaker and their tireless efforts to make sure that science stayed high on NASA's agenda. Nobody realized it yet, but the six Apollo landings would be the only opportunities to do "a little science on the Moon" for the rest of the twentieth century.

The Green, Green Glass of Hadley

In the course of three very busy days at the foot of Mount Hadley and the rim of Hadley Rille, Scott and Irwin had done way more than a little science. Like the three missions that had landed before them, they brought home a huge harvest of scientific information: photographs; descriptions of geological features; data transmitted from the instruments they placed on the Moon's surface; and most importantly, 168 pounds of rock and soil samples. This harvest would transform our understanding not only of the Moon's history but also of the whole solar system and our own planet.

In truth, Scott's hammer-and-feather experiment was not really typical of science on the Moon. To be sure, it was a fine tribute to Galileo, the man who conquered gravity intellectually long before NASA did it with rockets. And it was good public relations; it was a lot easier for the average person to comprehend than, say, the Suprathermal Ion Detector Experiment. But the outcome was a foregone conclusion. You don't have to go to the Moon to verify Galileo's theory; all you need is a sufficiently good vacuum chamber on Earth. George Adams, the inventor of one of the first air pumps, had done the same experiment two centuries earlier, using a guinea (a gold coin) and a feather. Adams's assistant had performed it for King George III of England, showing that British scientists, too, had a flair for public relations.

The more lasting payoff from the Apollo landings came from discoveries that no one had anticipated. For example, the previous day, August 1, while Scott and Irwin were exploring the steep slopes of the Hadley Delta, Irwin had noticed a large boulder on the hillside that looked green when viewed from a certain angle. "Can you

imagine finding a green rock on the Moon?" Scott recounted later. "Think about that. We'd never had any green rocks in training. . . . Nobody has ever told you ever before, in any class that we could remember, [about anything green] other than olivine, and this clearly was not olivine—and, all of a sudden, you've got green! Man, that's something you go for regardless of how steep it is."

While controllers in Houston listened with a growing sense of alarm (the TV camera was turned off at the time, so they couldn't see what was happening), Scott parked the Lunar Rover on a fifteen-degree slope. This may not sound like much, but the slope was covered with loose powder. One wheel of the rover was dangling out in midvacuum, and Irwin had to hang onto the vehicle after they got out, to keep it from slipping downhill. Scott chipped off a one-pound fragment of the boulder, which became lunar sample number 15405, and dug up some green soil as well.

Scientists would discover later that the soil was full of tiny spheres of green glass, the frozen remnants of a "fire fountain" that erupted three and a half billion years ago, near the edge of the Imbrian Basin, in a spectacular sideshow to the formation of Mare Imbrium. The lava had cooled so suddenly as it vented into space that it rained back down in the form of glass beads. Scott was right that the rock was not olivine (a green mineral sometimes found in volcanic deposits), but the glass beads that coated it had come from an olivine-rich source deep in the Moon's mantle. That was what made the find so remarkable: the depth and purity of the source. Thirty years later, geologists are still talking about it. To explain why, we have to back up to the first and most famous Moon landing.

First Impressions

In spite of its fame, *Apollo II* was by far the least ambitious Moon landing from a scientific point of view. Mission planners for NASA picked the flattest, easiest landing site they could—the smooth, volcanic plain of the Sea of Tranquility—and were prepared with back-up targets in case anything went wrong. Astronauts Neil Armstrong and Buzz Aldrin spent only two and a half hours walking on the Moon, barely an eighth of the time that Irwin and Scott would get. They collected 48 pounds of soil and rock samples to Irwin and Scott's 168. Their stripped-down experiment package contained only



A moment of high drama, for both science and lunar exploration. *Apollo 15* astronaut Dave Scott snapped this photograph, which shows a green-colored boulder in the foreground, with his geologist's rake resting on top. In the background, astronaut Jim Irwin struggles to keep the precariously balanced Lunar Rover from sliding downhill. The samples Scott took from this boulder, and the surrounding soil, turned out to be worth the trouble. They contained beads of green glass that erupted from deep inside the Moon 3.5 billion years ago, and provided crucial evidence about the depth of the Moon's "magma ocean." *Photograph courtesy of NASA.*

three instruments: a seismometer, a solar wind collector, and a laser reflector. By comparison, the *Apollo 15* astronauts had to set up eight considerably more sophisticated experiments.

Nevertheless, first impressions are the most enduring, and that was certainly the case with the first Apollo landing. Millions of people remember Neil Armstrong's ghostlike first step on the Moon, while only diehard space junkies (including the author, who was a twelve-year-old boy at the time) can recall Scott and Irwin's ramble around the breathtaking vistas of Mount Hadley.